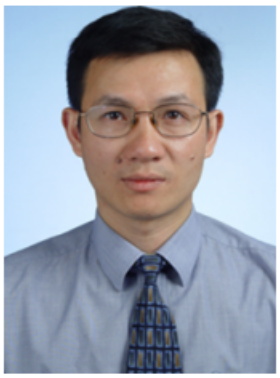
化学反应器理论 Theories for Chemical Reactors

- 教师介绍 Faculty



Lixiong WEN （文利雄）

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Research Field: Chemical process intensification technology; Micro-Nano Materials; Interface and material science

Education

August, 1997 – April, 2001:
Tulane University, New Orleans, Louisiana, USA
PhD in Chemical Engineering

September, 1992 – March, 1995:
Institute of Chemical Metallurgy, Chinese Academy of Sciences, Beijing, China
MS in Chemical Engineering

September, 1988 – June, 1992:
Zhejiang University, Hangzhou, China
BS in Chemical Engineering

Work Experience

October, 2003 - present: Professor
College of Chemical Engineering, Beijing University of Chemical Technology

October, 2002 – September, 2003: Associate Professor
College of Chemical Engineering, Beijing University of Chemical Technology

May, 2001 – August, 2002: Engineer
Intel Corporation, Los Angeles, California, USA
April, 1995 – July, 1997: Research Assistant
Institute of Chemical Metallurgy, Chinese Academy of Sciences, Beijing, China

Some representative publications

1. Tian-Yu Guo, Kun-Peng Cheng, **Li-Xiong Wen***, Ronnie Andersson*, Jian-Feng Chen. **3D Simulation on Liquid Flow in a Rotating Packed Bed Reactor**. *Industrial & Engineering Chemistry Research* 2017, 56 (28): 8169-8179
2. Tian-Yu Guo, Xin Shi, Guang-Wen Chu*, Yang Xiang, **Li-Xiong Wen***, Jian-Feng Chen. **Computational Fluid Dynamics Analysis of the Micromixing Efficiency in a Rotating-Packed-Bed Reactor.** *Industrial & Engineering Chemistry Research* 2016, 55: 4856-4866
3. Zhi-Wei Liu, Qing-Cheng Zhang, **Li-Xiong Wen***, Jian-Feng Chen. **Preparation of Ultrafine Manganese Dioxide by Micro-Impinging Stream Reactors and Its Electrochemical Properties**. *The Canadian Journal of Chemical Engineering* 2016, 94 (36): 461-468
4. Qing-Cheng Zhang, Zhi-Wei Liu, Xiao-Hua Zhu, **Li-Xiong Wen***, Qiu-Feng Zhu*, Kai Guo, Jian-Feng Chen. **Application of Micro-impinging Stream Reactors in the Preparation of CuO/ZnO/Al2O3 Catalysts for Methanol Synthesis**. *Industrial & Engineering Chemistry Research* 2015, 54 (36): 8874-8882
5. Ping Wang, Yu-Jing Zhao, **Li-Xiong Wen***, Jian-Feng Chen, Zhi-Gang Lei. **Ultrasound-microwave Assisted Synthesis of MnO_2 Supercapacitor Electrode Materials.** *Industrial & Engineering Chemistry Research* 2014, 53: 20116-20123
6. Zhiwei Liu, Lei Guo, Tianhao Huang, **Lixiong Wen***, Jianfeng Chen*. **Experimental and CFD Studies on the** Intensified **Micromixing Performance of Micro-Impinging Stream Reactors Built from Commercial T-Junctions.** *Chem Eng Sci* 2014, 119: 124-133
7. Zhiwei Liu, Qiufeng Zhu*, Ning Hou, Yao Fu, **Lixiong Wen***, Jianfeng Chen. **Development of novel monolithic catalyst with porous hollow silica nanoparticles for selective hydrogenation reactions.** *Catalysis Today* 2013, 216: 205-210
8. Xin Shi, Yang Xiang, **Li-Xiong Wen***, Jian-Feng Chen. **CFD Analysis of Liquid Phase Flow in a Rotating Packed Bed Reactor.** *Chemical Engineering Journal* 2013, 228: 1040-1049

9. Xin Shi, Yang Xiang, **Li-Xiong Wen***, Jian-Feng Chen. **CFD Analysis of Flow Patterns and Micromixing Efficiency in a Y-type Microchannel Reactor.** *Industrial & Engineering Chemistry Research* 2012, *51* (43): 13944-13952
10. Fang-Fang TONG, Hong XU, Jian YU, **Li-Xiong Wen*,** Jun ZHANG, Jia-Song HE. **Plasticization of [C_{12}MIM][PF_6] Ionic Liquid on Foaming Performance of Poly(Methyl Methacrylate) in Supercritical CO_2.** *Industrial & Engineering Chemistry Research* 2012, 51 (38): 12329-12336
11. Peng Cheng, Kang-Kang Jin, Jing Cheng, Fang Yang, Zhi-Gang Shen, Jian-Feng Chen, **Li-Xiong Wen***. **Controllable Precipitation of Naproxen Micro-Particles with Different Morphologies.** *PARTICUOLOGY* 2012, 10: 634-643
12. LI Wenjun, WU Di, SHI Xin, **WEN Lixiong*,** SHAO Lei. **Removal of organic matter and ammonia nitrogen in ADC wastewater by a combination of power ultrasound radiation and hydrogen peroxide.** *Chinese Journal of Chemical Engineering* 2012, 20(4): 754-759
13. Qiu-feng Zhu, Jin Gao, Jian-feng Chen, **Li-xiong Wen***. **Selective hydrogenation of acetylene over egg-shell palladium nano-catalyst.** *J. Nanosci. Nanotechnol.* 2010, 10 (9): 5641-5647
14. Jing Cheng, Jian-Feng Chen, **Li-Xiong Wen***. **Visual Study for Producing Zirconia Precursors with Two Reverse-Emulsion Precipitation Method.** *Ind. Eng. Chem. Res.* 2007, 46 (19): 6259-6263
15. Jian-Feng Chen, Ji-Rui Song, **Li-Xiong Wen***, Hai-Kui Zou and Lei Shao. **Preparation and Characterization of Agglomerated Porous Hollow Silica Supports for Olefin Polymerization Catalyst.** *Journal of Non-Crystalline Solids* 2007, 353 (11-12): 1030-1036.
16. Jing Cheng, Jianfeng Chen, Min Zhao, Qing Luo, **Lixiong Wen***, Kyriakos D. Papadopoulos. **Transport of Ions through the Oil Phase of $W_1/O/W_2$ Double Emulsions.** *Journal of Colloid and Interface Science* 2007, 305 (1): 175-182
17. Zhu-Zhu Li, Jian-Feng Chen, Ying Li, **Li-Xiong Wen***. **Adsorption of avermectin on porous hollow silica nanoparticles by supercritical technology.** *Journal of Nanoscience and Nanotechnology* 2007, 7 (2): 535-541
18. Fan Liu, **Li-Xiong Wen***, Zhu-Zhu Li, Wen Yu, Hai-Yan Sun, Jian-Feng Chen*. **Porous hollow silica nanoparticles as controlled delivery system for water-soluble pesticide**. *Materials Research Bulletin* 2006, 41: 2268–2275
19. Zhu-Zhu Li, Shi-Ai Xu, **Li-Xiong Wen***, Fan Liu, An-Qi Liu, Qing Wang, Hai-Yan Sun, Wen Yu, Jian-Feng Chen. **Controlled Release of Avermectin from Porous Hollow Silica Nanoparticles: Influence of Shell Thickness on Loading Efficiency,**

UV-shielding Property and Release. *Journal of Controlled Release* 2006, 111 (1-2): 81-88

20. Jie-Xin Wang, **Li-Xiong Wen***, Zhi-Hui Wang and Jian-Feng Chen. **Immobilization of Silver on Hollow Silica Nanospheres and Nanotubes and Their Antibacterial Effects**. *Materials Chemistry and Physics* 2006, 96: 90-97

21. Li-Min Xu, Jie-Xin Wang, **Li-Xiong Wen***, Jian-Feng Chen. **Fabrication and characterization of Ag-SiO_2 composite hollow nanospheres**. *The Journal of Materials Science* 2006, 41: 517–523

22. **Li-Xiong Wen***, Hao-Min Ding, Jie-Xin Wang, Jian-Feng Chen. **Porous hollow silica nanoparticles as carriers for controlled delivery of ibuprofen to small intestine.** *Journal of Nanoscience and Nanotechnology* 2006, 6 (9-10): 3139–3144

23. Jing Cheng, Shiai Xu, **Lixiong Wen***, Jianfeng Chen**. Steric Repulsion between Internal Aqueous Droplets and External Aqueous Phase in Double Emulsions.** *Langmuir* 2005, 21: 12047-12052

24. Jie-Xin Wang, **Li-Xiong Wen***, Run-Jing Liu and Jian-Feng Chen. **Needle-like calcium carbonate assisted self-assembly of mesostructured hollow silica nanotubes**. *Journal of Solid State Chemistry* 2005, 178 (7): 2383-2389

25. **Lixiong Wen***, Jing Cheng, Haikui Zou, Lei Zhang, Jianfeng Chen, Kyriakos Papadopoulos. **van der Waals Interaction Between Internal Aqueous Droplets and External Aqueous Phase in Double Emulsions**. *Langmuir* 2004, 20 (19): 8391- 8397

26. Zhu-Zhu Li, **Li-Xiong Wen**, Lei Shao, Jian-Feng Chen. **Fabrication of Porous Hollow Silica Nanoparticles and their Applications in Drug Release Control**. *Journal of Controlled Release* 2004, 98 (2): 245-254

27. **Lixiong Wen,** Rong Chang Wu, Elia Eschenazi, and Kyriakos D. Papadopoulos. **AFM of Amidine Latex Particles Attachment on Mica.** *Colloids & Surfaces A* 2002, 197: 157-165

28. **Lixiong Wen** and Kyriakos D. Papadopoulos. **Effects of Osmotic Pressure on Water Transport in $W_1/O/W_2$ Emulsions.** *J. Colloid Interface Sci.* 2001, 235: 398-404

29. **Lixiong Wen** and Kyriakos D. Papadopoulos. **Effects of Surfactants on Water Transport in $W_1/O/W_2$ Emulsions.** *Langmuir* 2000, 16 (20): 7612-7617

30. **Lixiong Wen** and Kyriakos D. Papadopoulos. **Visualization of Water Transport in $W_1/O/W_2$ Emulsions.** *Colloids & Surfaces A* 2000, 174: 159-167

31. Jinghai Li, **Lixiong Wen**, Wei Ge, Heping Cui and Jinqiang Ren. **Dissipative Structure in Concurrent-up Gas-Solid Flow.** *Chemical Engineering Science* 1998, 53(19): 3367-3379

32. Jinghai Li, **Lixiong Wen**, Guihua Qian, Heping Cui and Mooson Kwauk, Jaap C. Schouten and Cor M. Van Den Bleek. **Structure Heterogeneity, Regime Multiplicity and Nonlinear Behavior in Particle-Fluid System.** *Chemical Engineering Science* 1996, 51(11): 2693-2698

- **课程介绍 About Course**

Theories for Chemical Reactors

This course is mostly established for foreign MS students and it will be taught in English. It is also applicable to those Chinese MS students who are eager to improve their international perspective, fundamental knowledge in chemical reactor design and communication skills in English. The objectives of this course are to help students understand the fundamental theories and knowledge of the key processes of chemical industry, i.e., chemical reaction and reactors, and to train skills for analyzing, calculating and solving practical problems of chemical reaction processes in the production process.

Outlines:

1. Introduction (2 hour)
2. Kinetics of homogeneous reaction (3 hours)
3. Interpretation of batch reactor data (8 hours)
4. Ideal homogeneous reactors (2 hours)
5. Design for single reactions (6 hours)
6. Parallel reactions (2 hours)
7. Kinetics of multiple reactions and reactor design (2 hours)
8. Effects of temperature on reactions (3 hours)
9. None-ideal flow (5 hours)
10. Pure convection model, axial dispersion model and tanks-in-series model (8 hours)
11. Laminar flow (2 hours)
12. Gas-solid catalytic reactions (5 hours)

- 课程大纲 Syllabus

Theories for Chemical Reactors

Instructor: Lixiong Wen, Dr./Prof.

Course Code:

Hours: 48

Credits: 3.0

Prerequisites: Basic Chemistry

Description: The objectives of this course are to help students understand the fundamental theories and knowledge of the key processes of chemical industry, i.e., chemical reaction and reactors, and to train skills for analyzing, calculating and solving practical problems of chemical reaction processes in the production process.

Textbook: O. Levenspiel, 《Chemical Reaction Engineering》 3rd Edition, John Wiley & Sons, Inc. 1998

References: G. F. Froment and K. B. Bischoff, 《Chemical Reactor Analysis and Design》 2nd Edition, John Wiley & Sons, Inc. 1990

General Syllabus:

13. Introduction (2 hour)

    The tasks, contents and research methods of chemical reaction engineering; the concept of chemical reaction rate.

14. Kinetics of homogeneous reaction (3 hours)

    Description of reaction rate equation, molecularity and order of reaction.

15. Interpretation of batch reactor data (8 hours)

    The integral method and differential method for determining reaction kinetics equation; concentration, temperature, pressure and reaction rate; the search for a rate equation.

16. Ideal homogeneous reactors (2 hours)

    Concepts of batch, plug flow and mixed flow reactors, and establishment of their reaction rate equations.

17. Design for single reactions (6 hours)

    Comparisons between plug flow and mixed flow reactors; plug flow and mixed flow reactors in series and/or in parallel; Kinetic characteristics of recycle reactor and autocatalytic reactions.

18. Parallel reactions (2 hours)

    Kinetic characteristics of parallel reactions and applicable reactor types; Definition of selectivity and calculation of product distribution.

19. Kinetics of multiple reactions and reactor design (2 hours)

    Kinetic characteristics and calculation of product distribution for series-parallel reactions.

20. Effects of temperature on reactions (3 hours)

    Different operating modes of non-isothermal reactors; significance and calculation of adiabatic reaction operation lines; temperature stability of reactors.

21. None-ideal flow (5 hours)

    Definition of backmixing and its influence on process; density functions and distribution functions for residence time distribution, and their physical significance and calculation;

calculation of mean residence time and variance; residence time distribution function and numerical characteristics of ideal reactor.

22. Pure convection model, axial dispersion model and tanks-in-series model (8 hours)

    Definitions of these models; the physical significance of the parameters; and calculation of the conversion rates of reactors through these models.

23. Laminar flow (2 hours)

    The mixing properties of laminar flow; its non-ideality, description and detection.

24. Gas-solid catalytic reactions (5 hours)

Grading: Project 20%; Homework 30%; Final exam 50%.

- 教案 **Teaching Plan**
- 视频 **Video**